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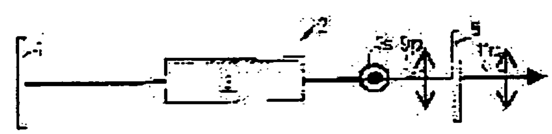
54) LASER RESONATOR FOR GENERATING POLARIZED LASER RADIATION

57)Abstract:
PROBLEM TO BE SOLVED: To provide a simple laser resonator for generating polarized radiation which has a high efficiency and can be easily adjusted and has a superior radiation stability.
SOLUTION: An active medium (19) has a double refraction power by thermal induction. A radiation field (23s, 25p) which oscillates in the laser resonator (15) is not polarization-selective, and only a radiation field (11p, 27p, 46p, 49p) in a desired polarized state (p) is partially separated from the radiation field (23s, 25p). A radiation separator (20) patially separates the only specified polarization (27p) out of the radiation field (23s, 25p) which can oscillate in the resonator (15) by a predetermined separation rate (Tp). All the radiation fields having another polarization and a residual part of the partially separable radiation field are left over in the resonator (15) completely reflected to an allowable limit, and hence the lasor resonator (15) uses a resonator mirror (17) having a high reflection factor, radiation separator (20), and active medium (19) having a double refraction power by thermal induction.



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NOTICES *

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:LAIMS

Claim(s)]
Claim 1] It is an approach for generating the laser output radiation (11p;27p;46p, 49p) which polarizes by the laser :avity (2, 15, 30; 53) which an active medium (3; 19; 33; 52) presents the birefringence by which heat induction is :arried out. Polarization selection is made only by the radiation field (7s, 9p;23s, 25p;47s, 45p) which vibrates in a laser :avity (2, 15, 30; 53) passing along at least one of two resonator mirrors. The approach characterized by separating electively only the radiation field (11p;27p;46p;49p) which has a desirable polarization condition (p) from the radiation ield (7s, 9p;23p, 25p;47s, 45p).
Claim 2] The approach according to claim 1 characterized by making energy transfer between the radiation fields (7s, 'p;23s, 25p;47s, 45p) which vibrate in a resonator (2, 15, 30; 53).
Claim 3] The approach according to claim 2 characterized by performing energy transfer by phase delay in the regular ›olarization direction.
Claim 4] The approach according to claim 1 characterized by only for the radiation field by which depolarization is not :arried out returning and being combined to a certain degree of separation among the radiation fields which can vibrate vithin a resonator by the birefringence by which heat induction of the active medium is carried out.
Claim 5] Claim 1 - In an approach according to claim 3 The resonator mirror of a high echo (1; 17; 31; 57), It is a laser :avity (2, 15, 30; 53) for generating the laser output radiation (11p;27p;46p, 49p) which polarizes with a radiation lecollator (50 5;20;37; 55) and the active medium (3; 19; 33; 52) which presents a heat birefringence. A radiation lecollator (50 5;20;37; 55) In a resonator (2, 15, 30; 53) only a regular polarization condition thru/or regular ›olarization distribution (11p;27p;46p, 49p) among the radiation fields (7s, 9p;23s, 25p;47s, 45p) which can vibrate The adiation field where it is [in] selectively disengageable from a resonator (2, 15, 30; 53) at regular degree of separation Tp), and another polarization was made, The remaining component of the disengageable radiation fields is a laser :avity (2, 15, 30; 53) characterized by being constituted so that it may be thoroughly reflected in a resonator (2, 15, 30; ;3) and may remain to a tolerance limit selectively.
Claim 6] There is at least one optical energy transfer element (54 3; 21, 19; 33, 35; 52, 55) in a resonator (2, 15, 30; ;3). This is a laser cavity according to claim 5 characterized by acting on the energy transfer between the radiation ields (7s, 9p;23s, 25p;47s, 45p) in a resonator (2, 15, 30; 53) which polarize variously which cannot be disregarded.
Claim 7] A radiation decollator (50 5;20;37; 55) presents a separation mirror (5; 20; 37; 50). This mirror penetrates the ›olarization distribution (p) as which the radiation field of a resonator (2, 15, 30; 53) was specified with regular ›ermeability (Tp). Suitably The laser cavity according to claim 5 or 6 characterized by all the radiation fields (7s, 'p;23s, 25p;47s, 45p) vibrating between [same / two] resonator mirrors (2, 15, 30; 53).
Claim 8] The laser cavity according to claim 6 characterized by for an energy transfer element (3 19; 33; 52) presentin; ι birefringence, and presenting the birefringence by which heat induction is carried out about the radiation field which /ibrates in a resonator (2, 15, 30; 53) especially (2, 15, 30; 53).
Claim 9] The laser cavity according to claim 6 to which an energy transfer element presents phase delayed action abou he polarization condition of the radiation field that it can vibrate, in a resonator, and is suitably characterized by to be :onstituted as lambda/4 plate (21; 35; 54) thru/or that the optical operation is shown or to be especially constituted as a 'araday rotator thru/or showing the optical operation (15 30; 53).
Claim 10] It is the laser cavity according to claim 9 characterized by having the separation mirror (50) which a 'adiation decollator penetrates thoroughly suitably with the permeability of a convention of only the nonlinear optical :lement (55) which performs the increment in a frequency of the radiation field which can vibrate in a resonator (53), ınd the radiation by which the increment in a frequency was carried out (53).
Claim 11] According to an approach according to claim 1 or 4, with the active medium (3) which presents the resonato nirror (1) which carries out a high echo, a separation resonator mirror (5), and the birefringence by which heat

nduction is carried out It is a laser cavity (2) for generating polarization laser output radiation. At least one of both esonator mirrors (1) reflects only the radiation field with a certain polarization distribution. In case this radiation field ›asses an active medium (3), depolarization does not carry out. It is the laser cavity which does not reflect all of the adiation field of other polarization conditions, or reflects only few parts inadequate for vibrating, and is characterized ›y the ability of the radiation field of others of another polarization condition not to vibrate by it at a resonator (2).

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the laser cavity for generating the laser radiation to which the whereas clause publication of the approach for generating the polarizing laser radiation according to claim 1 and claim 5 thru/or claim 11 polarizes.
[0002]
[Description of the Prior Art] A resonator mirror means the mirror in which the radiation field vibrates between mirrors. Fundamentally, with a high reflecting mirror, a little, each oscillator has the low separation mirror of a reflection factor, and is separated through this mirror for the object with a part of various radiation fields. On these descriptions, it is not considered that the mirror inside the resonator for the turn of radiation or the other objects is a resonator mirror.
[0003] In the approach of this invention indicated thru/or the laser cavity of this invention, a polarization condition thru/or polarization distribution are linearity, and means polarization of the letter of a link. The polarization condition which progresses to a radial or is adjusted, and the polarization condition which progresses by the tangent which may be produced in the case of the laser rod which it is symmetrical with especially a cylinder, and a pumping is carried out, and carries out a birefringence with heat, or is adjusted are also included in this. In addition, the polarization direction which changes to arbitration locally is also included through a radial section.
[0004]
[Problem(s) to be Solved by the Invention] It has high effectiveness, and adjustment is easy and it is offering the easy laser cavity for generating the polarization radiation with the outstanding radiation stability.
[0005]
[Means for Solving the Problem] The technical problem of this invention is solved by separating selectively only the radiation field (radiation) which has the specified polarization distribution from the radiation field which vibrates in a laser cavity. It dissociates selectively, and also including the component which remains in the resonator, the remaining radiation remains in a resonator and is vibrating. For this reason, the laser cavity which has the resonator mirror, radiation decollator, and active medium which carry out a high echo is used. It is constituted so that only one specified polarization vibrates in a resonator, and especially radiation decollators may be regular degree of separation about the only polarization from the **** radiation field in polarization of arbitration and can be separated from a resonator. The radiation field where another polarization was made, and the radiation field which was separated selectively and remain remain in the resonator, reflecting to a tolerance limit thoroughly.
[0006] Suitably, the radiation field of the whole laser cavity vibrates between two resonator mirrors. Between the radiation fields of a laser cavity, energy transfer is performed suitably. Phase delay can perform such energy transfer in the regular polarization direction. the element which carries out the birefringence of the ability to become an energy transfer element -- it is laser Xtal, lambda/4 plate, or faraday rotator of a heat birefringence suitably. About another insert, reference is made below.
[0007] The nonlinear optical element in a resonator can also be used for radiation separation. A frequency can be increased with the element. A separation mirror penetrates suitably only the radiation which the frequency increased.
[0008] In the laser cavity which has the solid-state-laser medium of a birefringence which is suitably used by high power laser, and by which heat induction is carried out known until now, in order to compensate such a birefringence by which heat induction is carried out, big efforts were paid. This invention proposes an option to the known laser cavity which has the active medium in which heat induction carries out a birefringence. It is not necessary to compensate the birefringence of heat induction with this invention. A birefringence is used reversely. With some operation gestalten, the activity solid-state medium of the birefringence of heat induction etc. is used as an element for the energy transfer

between the radiation fields which polarized variously [a resonator]. Please care about that only the radiation field which has that the radiation field of the whole resonator returns and is reflected and a desirable polarization condition thru/or desirable polarization distribution is separated with regular permeability with a certain operation gestalt.

[0009] The optical resonator with which the birefringence of heat induction of an active medium is compensated by the optical element of a resonator is "optical resonator" 298 pages and of for example, N.Hodgson and H.Weber work or subsequent ones (the Springer publication, 1997), and DE-A. 44 15 It is described by 511.

[0010] In this invention, two or more specified polarization directions are also separable. Suitably, it limits only to one.

[0011] The radiation decollator of this invention has one separation mirror suitably, and this mirror is penetrated with the permeability to which only the laser radiation which has the specified polarization condition thru/or the wavelength specified [were specified and it was polarization-distributed] was specified. Such a mirror is Rong-Chung. Tyan, Pang-Chen Sun, Axel Scherer and Yeshayahu It is indicated by 206-212 pages in "Collaboration SPIE" 1782 No. besides "polarization" of the beam splitter based on the anisotropy spectrum refraction property of the multilayer grid of a gestalt birefringence" of Fainman collaboration, optical Letters, 21 volumes, No. 10, May 15, 1996, 761-763 pages, and N.Bel'tyogov, and 1992. In addition, such a mirror is indicated by PCT/EP 00/07540.

[0012] Also being able to use an optical element nonlinear as a radiation decollator, this performs suitably the incremen in a frequency of the radiation field which can vibrate in a resonator. The mirror thoroughly penetrated as a separation mirror with the permeability of only one convention in the radiation field which carried out the increment in a frequency is used.

[0013] For the energy transfer between the radiation fields of a laser cavity, as stated previously, the optical element of birefringence, especially the optical element of a heat induction birefringence are used. That is, by solid state laser, lase Xtal of a heat induction birefringence can become an active medium, for example for energy transfer.

[0014] An energy transfer element can perform phase delay (phase revolution) about the radiation field in a resonator which can be vibrated, suitably, is constituted as lambda/4 plate, and can show the optical operation. It can also constitute as a faraday rotator.

[0015] As the theory explained below shows, in the laser cavity of this invention, 30% or more per resonator revolution of the resonator radiation field of rate of depolarization is obtained. Generally the birefringence of heat induction make strong association with high power laser Xtal. Depolarization "sufficient" when depolarization is little pumping output is obtained with additional elements, such as lambda/4 plate and a faraday rotator.

[0016] However, also from the radiation field in a resonator which can be vibrated, it returns and only the radiation fiel as for which depolarization is not carried out by the birefringence of heat induction of an active medium can be combined until it becomes a certain degree of separation. In this case, at least one of two resonator mirrors reflects only the radiation field which has a certain polarization distribution. Since the depolarization of them is not carried out in case those fields pass an active medium, the radiation field of another polarization condition is not reflected or it reflect at few rate inadequate for vibrating, the radiation field of others which have another polarization condition in a resonat is unable to vibrate. By such mirror coat, the mirror which carries out a high echo, a separation mirror, or both mirrors can also be attached (however, there is no advantage in this).

[0017] By modification of the laser cavity of this invention thru/or its operation gestalt, the high power laser accompanied by good radiation quality can be manufactured. Good radiation quality, for example, the radiation quality accompanied by polarization of the letter of a link, can be used for the industrial laser for cropping. A notation is used for below and the approach of this invention thru/or the operation gestalt of a laser cavity are explained to it in detail. The advantage of this invention becomes clear from the description text.

[0018]

[Embodiment of the Invention] The laser cavity 2 shown in drawing 1 has the high reflecting mirror 1 (called a mirror 100%), an active medium 3, and the radiation decollator 5. An active medium 3 is Nd:YAG laser Xtal, and is 28.8mm i the diameter of 4mm, and die length. It is prepared between the high reflecting mirror 1 and the decollator 5. The pumping of laser Xtal 3 is sideways turned through die length of 10mm of six laser diodes by wavelength lambdap=809nm. The generated laser wavelength is lambdal=1.064micrometer. The laser head which consists of array of a laser diode by which the pumping was carried out to laser Xtal 3 is indicated by the "heat optical property of the synthetic YAG rod by which the pumping was turned sideways which has the core by which Nd doping was carried ou of collaboration besides for example, A.Lucianetti, a quantum electronics IEEE journal, No. 36, and 220-227 pages February, 2000).

[0019] The mirror 1 which carries out a high echo has the highest possible reflection factor, i.e., the reflection factor to 100% of tolerance limits, about the laser radiation lambdal=1.064micrometer wavelength which should be generated. A decollator 5 consists of one polarizing mirror. In a laser cavity 2, it vibrates in the state of all the polarization directions

that can consider many radiation fields (it can express also as the mode if there is a certain amount of prerequisite) according to a transient. Only radiation field 9p which vibrates to parallel at 7s which vibrates vertically to a sign side, and it is shown in drawing 1 . All the other radiation fields can carry out a spectrum by the vector in this direction. About all the radiation fields, the polarizing mirror 5 is polarization 9p parallel to a sign side, and it is constituted so tha it may have a reflection factor 1 (tolerance is included). That is, the return echo of these radiation fields is carried out thoroughly. However, a part of energy of radiation field 9p which carried out parallel polarization penetrates a mirror 5 as radiation 11. The permeability of a mirror 5 is fitted to magnification thru/or the pumping output of laser Xtal 3 according to the following operation gestalten.

[0020] Spacing 1c of the mirror 1 of a high echo and conoscope 5 is 210mm. Spacing with 60mm and conoscope 5 of spacing of laser Xtal 3 and the high reflecting mirror 1 is 35mm.

[0021] The resonator 15 shown in drawing 2 is similar to the resonator 2 of drawing 1 , and has the conoscope 20 as the high reflecting mirror 17, laser Xtal 19 as an active medium which carries out a heat birefringence, and a radiation decollator. In addition, a resonator 15 has lambda/4 plate 21. The optical axis of lambda/4 plate 21 is in a sign side here in the location of 45 degrees to the direction of the radiation field which vibrates to parallel. When it passes along the radiation field which polarizes polarization of the radiation field of a laser cavity 15 in the shape of a link once, and when returning after lambda/4 plate 21 carries out a whole echo with the high reflecting mirror 17, it is changed into the radiation field which is rotated 90 degrees to the advancing radiation field and which carries out linearity polarization. The radiation p which it polarizes to parallel and vibrates to a sign side is converted into the radiation s which vibrates vertically. Like drawing 1 , the vertical polarization direction s (radiation which presents the radiation vector in which a spectrum is possible in the radiation field which vibrates at right angles to a sign side thru/or this direction) is displayed in 23s, and is rotated 90 degrees, and the parallel polarization direction p is expressed with 25p also here. Output radiation 27p which presents one parallel polarization p with the specified permeability 0.2 arises through conoscope 2C

[0022] Energy transfer between the radiation fields (mode) which vibrate in the different polarization direction in a lase cavity 15 is performed through laser Xtal 19 and lambda/4 plate 21 here, when it is carried out through lambda/4 plate 21 and laser Xtal 19 is carrying out the birefringence. The weak heat birefringence of laser Xtal, for example, the heat birefringence in the case of a weak pumping, is supported with lambda/4 plate 21 the component to which the polarization condition of a resonator is changed, and here.

[0023] The resonator 30 of drawing 3 is similar to the resonator 15 of drawing 2 , it has the high reflecting mirror 31, laser Xtal 33 used as an active medium, and lambda/4 plate 35, and these operations resemble the operation of lambda/4 plate 21. The inclined optical element 37 which has a dielectric layer on the front face of up as a radiation decollator here, and another high reflecting mirror 39 are formed. An optical element 37 is a transparent plain parallel body about laser radiation. This inclines at the include angle nu to the optical resonator shaft 41, one dielectricity-layer 44 is shown in the up front face 43 suitable for laser Xtal 33, and a layer penetrates one radiation field which polarized 45p with the permeability of 0.12 to parallel to a sign side, corresponding to desirable degree of separation, as shown in drawing. Radiation field 47s which polarizes vertically, it is reflected nearly thoroughly and a return echo is carried out at itself through the mirror 39 which carries out a high echo. However, since 12% of the radiation deflected by parallel was removed by the sign side by p-polarized light 46p as output radiation 46, it is reflected, the 88 remaining% carries out a return echo from a mirror 39, and an optical element 37 penetrates 12% by p radiation 49p similarly as the second output radiation 49. Both output radiation 46 and 49 is only suitably repeated [one] coherent in consideration of different progress time amount (twice of spacing of a mirror 39 and an optical element 37).

[0024] The whole resonator radiation field vibrates only one optical resonator also here (= the only equivalence type). That is, it becomes the mirror 31-lambda/4 plate 35-laser Xtal 33-optical element 34-high reflecting mirror 39 which carries out a high echo, and returns again.

[0025] The resonator 53 of drawing 4 resembles drawing 2 , and has the composition of having laser Xtal 52 which becomes an active medium, lambda/4 plate 54, the separation mirror 50, and the high reflecting mirror 57. Of course, as an additional element, it has the optical element 55 which acts nonlinear, and it can perform frequency redoubling. The radiation "is not doubled" although the radiation "by which frequency redoubling was carried out" is passed does not pass the separation mirror 50.

[0026] thus, in case heat induction is carried out and the active medium which carries out a birefringence is passed, only the radiation field with regular polarization distribution reflects about the radiation field where polarization is not canceled -- as -- polarization -- it becomes possible to constitute an alternative resonator mirror. The radiation field where another polarization was made is not reflected by this resonator mirror, or only a part is reflected. The radiation field where such another polarization was made does not vibrate any longer in a resonator. This kind for generating the

laser output radiation which polarized of laser cavity has only an active medium and two resonator mirrors. It becomes possible to also constitute the resonator mirror or separation mirror of a high echo on a polarization selection target. However, the resonator mirror of a high echo consists of fields of cost on a polarization selection target. That is, only a regular polarization condition is reflected, and it does not reflect or is made to reflect others all slightly. The separation mirror is not constituted by the polarization selection target any longer. It is symmetrical with a cylinder and, in the case of the solid-state-laser medium of the rod gestalt by which a pumping is carried out, such radiation polarizes by the radial or the tangent. If an activity solid-state medium is made another configuration and the location of the source of a pump is changed, another local polarization distribution will arise in laser radiation. A polarization selection mirror must be adjusted according to the configuration.

[0027] Next, a judgment is made about transparency of conoscopes 5 and 20, and an optical element 37. Based on laser Xtal 3 and 19 thru/or the heat birefringence of 33, a mutual intervention is mutually made between two vertical photons (photon), the polarization directions s and p thru/or 7s, 9p, 23s and 25p, or 47s and 45p. That is, the 7s of the two polarization directions, 9p, 23s and 25p, or 47s and 45p are mutually combined from the polarization life TDepol. TDepol is one scale which shows the time amount in a certain polarization condition before one photon changes to another polarization condition.

[0028] A degree type is effective about quantity change of the ion for every capacity unit on basic level (it displays by "g" with the bottom) for every time basis so that it may be applied about the wavelength of 1.064 micrometers in the case of Nd:YAG Xtal on the assumption that 4 level system.

[Equation 1]

$$\frac{dn_g}{dt} = \frac{n_l}{\tau_l} - P_n(n_g) + \frac{n_u}{\tau_u} \cdot \beta_{ug} \cdot$$

[0029] A degree type is effective about the temporal response of the quantity of the ion for every capacity unit in the low level (it displays by "l" with the bottom) of a primitive state.

[Equation 2]

$$\frac{dn_l}{dt} = \frac{n_u}{\tau_u} \cdot \beta_{ul} + (\Phi_s + \Phi_p) \cdot c \cdot \sigma \cdot (n_u - n_l) - \frac{n_l}{\tau_l} .$$

[0030] Nu is the quantity of the ion in the level by which up excitation was carried out for every capacity unit, and Nl is the quantity in low level.

[Equation 3]

$$\frac{dn_u}{dt} = Pw(n_g) - \frac{n_u}{\tau_u} - (\Phi_s + \Phi_p) \cdot c \cdot \sigma \cdot (n_u - n_l)$$

$$\frac{d\Phi_s}{dt} = \Phi_s\ c \cdot \sigma \cdot (n_u - n_l) \cdot \frac{l_k}{l_c} - \frac{\Phi_s}{\tau_s} + \frac{1}{\tau_{Depol}} \cdot (\Phi_p - \Phi_s) + \cdot \frac{n_u}{\tau_u} \cdot \beta_{ul} \cdot \frac{l_k}{l_c}$$

$$\frac{d\Phi_p}{dt} = \Phi_p c \cdot \sigma \cdot (n_u - n_l) \cdot \frac{l_k}{l_c} - \frac{\Phi_p}{\tau_p} + \frac{1}{\tau_{Depol}} \cdot (\Phi_s - \Phi_p) + R \cdot \frac{n_u}{\tau_u} \cdot \beta_{ul} \cdot \frac{l_k}{l_c}$$

[0031] phis and phip are the quantity of the photon for every capacity unit in the direction of s-polarized light thru/or the direction of p-polarized light. The life of the upper laser level is Tu=230microsecond, and the life of low laser level is Tl=30ns. betaul and betaug are expressed as "branching" condition and have numeric values 0.8 and 0.2. R is a radiation parameter and shows the probability for the photon called for momentarily to remain in a resonator. R= 10 to 4 degree (s the speed of light. Ik is the die length "to which the pumping of laser Xtal was carried out", Ic is resonator die length, and sigma is the operation cross section for the excited emission, and is 2.8x10 to 19 cm2. The life of the photon in a resonator is searched for by the degree type about the two polarization directions.

[Equation 4]

$$\tau_{s,p} = \frac{2 \cdot l_c}{c \cdot [V - \ln(1 - T_{s,p})]} ,$$

[0032] However, V is internal loss and Ts and Tp show the permeability of the conoscope about the direction of s-

›olarized light thru/or the direction of p-polarized light. Since a part of radiation by p-polarized light is separated and s-›olarized light is reflected thoroughly, it is Ts=0.
0033] Function Pn (ng) shows the quantity of the ion after the pumping radiation absorbed for every time basis and :very capacity unit.
Equation 5]

$$'_n(n_g) = \frac{P_p \cdot \eta_{trans}}{h \cdot \nu_p \cdot \pi \cdot r_p^2 \cdot l_k} \cdot \left[1 - e^{\sigma_{abs} \cdot n_g \cdot l_k} \right] .$$

0034] Pp(s) are pumping capacity and an optical propagation multiplier concerning [etatrans] pumping radiation. **** s the frequency of pumping radiation. It is 3.708x1014Hz. sigmaabs is an absorption cross section about pumping adiation, and is 3x10 to 18 mm2. rp is the radius of laser Xtal and is 2mm.
0035] In order to judge the polarization life TDepol, the birefringence in laser Xtal by which heat induction is carried ›ut is taken into consideration. The general analytical model is indicated by 1398-1404 pages in collaboration "heat ›irefringence of laser rod accompanied by analytical-model [of temperature distribution], and cylinder symmetry ıeating" J.Opt.Soc.Am.B;17 volume besides M.Schmid, No. 8, and August, 2000. The joint property of a photon of :hanging polarization in one passage is as a degree type.
Equation 6]

$$'_{Depol} = D_{biref} = \frac{1}{\pi \cdot r^2} \int_0^{r_{rod}} \int_0^{2\pi} b(r', \varphi)\, f_{beam}(r') r' d\varphi\, dr' .$$

0036] b (gamma', psi) shows a heat birefringence and can calculate it according to the above-mentioned reference.)biref is the average of the birefringence to which the interior of laser radiation was guided. The numeric value of)biref is from 0 to 0.5. If lambda/4 plate 21 is in a resonator 15, all photons will carry out 90-degree polarization evolution. Since depolarization is carried out thermally, a part of polarization revolution caused on lambda/4 plate 21 is ›ffset.
Equation 7]

$$'_{Depol} = 1 - D_{biref},$$

)Depol is from 0.5 to 1.
0037] A polarization life is searched for by the degree type.
Equation 8]

$$_{Depol} = \frac{2 \cdot l_c}{c \cdot D_{depol}} .$$

n order to analyze balance equality numerically, the spatial distribution of pumping radiation and the spatial energy .istribution of laser radiation are taken into consideration.
0038] In the following count, approximate-value-assessment performed by the 4th degree of Rung-Kutta-Methode by ⁄IathCad is made an issue of. The die length Ic of a laser cavity is 210mm. Laser Xtal is die length of 28.8mm, and a adius rc is 2mm. 10mm (Ik) of laser Xtal is emitted from the pump light radiation Pp. It is a premise that laser Xtal is mitted uniformly. Internal loss V is 0.05 and optical propagation multiplier etatrans is 0.8.
0039] First, the effect of laser output Pout on the permeability of Depolarization Ddepol and conoscope 20 is onsidered (based on a Ts=0 definition). The pumping output Pp is 196W.
0040] Laser output Pout is indicated by W by drawing 5 as a function of the joint property about the permeability from ⁄hich conoscope 20 differs. The permeability for p-polarized light is always 0. The continuous line is effective about ·ermeability 0.2, and it relates [a longer broken line is related with the permeability of 0.1, and / a dotted line] with the ·ermeability of 0.05 and is effective. 0.3 or more permeability could not be taken into consideration by the numerical pproach which makes reference here. Upward arrow-head 59a to 59c shows a curving point, and the life of the photon ı the p-polarized light Tp in this curving point is the same as the polarization life TDepol. The dotted line 61 currently rawn vertically [drawing 5] shows a curving point, and is TDepol=Ts at a curving point. Although the permeability o: -polarized light is zero, naturally it still has polarization loss with a resonator also about such a polarization direction.
)041] Laser output Pout is dependent on the polarization joint property TDepol about the field of TDepol>Ts. Iowever, there is also a saturation region about TDepol<Tp. For an efficient activity, it must be TDepol<Tp.
)042] If TDepol is smaller than Tp, a mutual intervention will be quickly made between the two polarization directions

;o that it may be substituted for the photon which leaves a resonator with the photon of another polarization direction.

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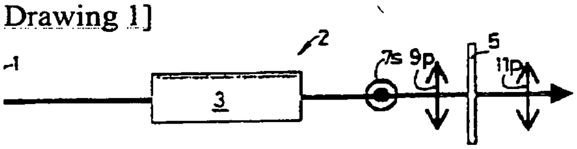
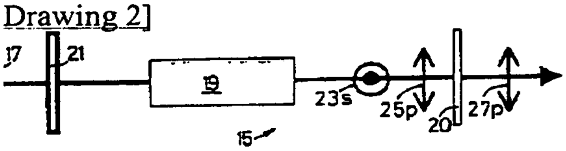
DRAWINGS

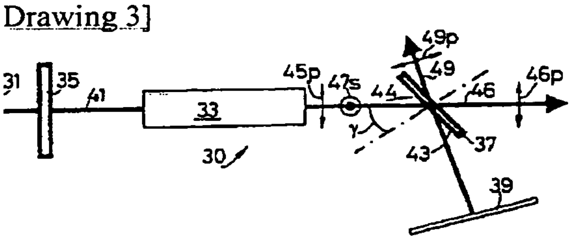
[Drawing 1]



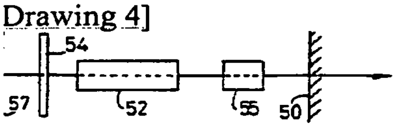
[Drawing 2]



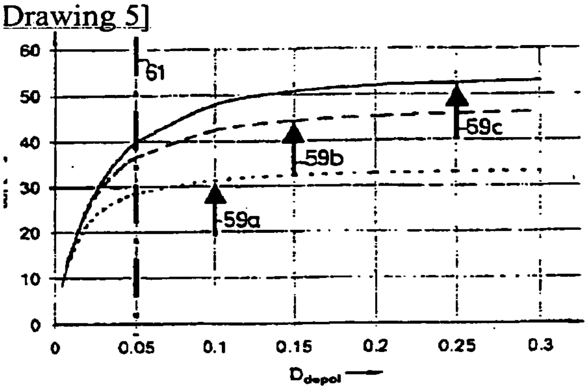
[Drawing 3]



[Drawing 4]



[Drawing 5]



[Translation done.]